PHENIX

PHENIX mRPC GAS SYSTEM OPS in the mRPC Test Lab

procedure name

PHENIX Procedure No. PP-2.5.2.20-1

Revision: A **Date: 5/28/2013**

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

- *Typo: On the Revision Control Sheet, the "Approved By" column is blank. It should have 4 names on it, since this procedure was signed by 4 people.*

Approvals

5/29/13
PHENIX Cognizant Scientist/ Date
Engineer/Activity Manager

5-30-13
PHENIX Cognizant Scientist/ Date
Engineer/Activity Manager

DON LYNCH
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5/31/13
CA-D ESRC

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REVISION CONTROL SHEET

LETTER	DESCRIPTION	DATE	AUTHOR	APPROVED BY	CURRENT OVERSIGHT
A	First Issue (Note: Derived from PP-2.5.5.15-1 procedure used for RPC factory gas system operations.)	5/28/2013	R.Pisani(using D. Northacker written procedure for RPC factory gas system operations.)		R. Pisani

Introduction:

This system is designed to provide mixed gas for up to 1 mRPC vessel located in the mRPC Test Lab area inside Building 912. There are two separate HV tests available for mRPC, originally designed as one for incoming components, and one for finished detectors. The mRPC test chambers may utilize either. A mixture containing 95% Freon 134a, 4.5% isobutane, and 0.5% sulfur hexafluoride is used for both tests. The isobutene and SF6 will be slaved to the R134a to prevent these gases from flowing without R134a. All exhaust from the tests is gathered in a common line and vented outside of the building.

The present system will provide a maximum of about 250 ccm total flow that would be distributed between both setups. Each chamber will receive a smaller quantity of mixed gas, and will be operated at a pressure less than 10 inches of water. The cylinders connected to the system are located inside Building 912, but outside the tent area. The regulation/shutoff rack and the mixing rack are also outside the tent, against an adjacent shielding block. There will be gas leak detectors installed in the vicinity of the rack that are sensitive to all three gases used, and if activated will shut off all three components. The solenoid valves used for this purpose will also shut off flow in the event of a fire alarm or power outage within the building.

1.0 Purpose and Scope

The goal of this procedure is to instruct **authorized** mRPC test lab personnel in the correct procedure for starting the mRPC test lab gas system and for purging the mRPC chambers with dry Nitrogen prior to the introduction of a mixture with a flammable component.

This procedure contains the steps necessary to start the mRPC test lab gas system from a fully shutdown state and to purge the mRPC detectors with Nitrogen. In this operation, Nitrogen gas is routed from a bottle that resides inside of Building 912 through all portions of the mRPC test lab gas system and then into the mRPC chambers. The gas from the chambers is vented to the Vent line outside Building 912. The gas flow will be about 0.250 liter per minute (LPM).

At the end of this procedure the mRPC chambers can be maintained in a standby state with a low flow of Nitrogen or the operator can continue on and run with R134A+4.5% isobutane/ 0.5% SF6 Mixture.

In addition to the Operating Procedures this document specifies the Local Emergency Plan of the mRPC test lab. This Local Emergency Plan will ensure:

1.1 The safety of all personnel from risks associated with the operation of the mRPC test lab gas system

1.2 The implementation of the appropriate emergency procedures

1.3 Prompt notification of the appropriate C-A and S&EP specialists

1.4 The maintenance of appropriate C-A emergency status

1.5 The preservation and protection of the environment

1.6 The preservation of BNL facilities and equipment

2.0 Responsibilities –

During mRPC test lab operations, there will be two levels of responsibility for the oversight of the mRPC test lab gas systems: the mRPC test lab crew and the mRPC Authorized GAS experts. A list of Authorized personnel will be posted at the mRPC tent door.

The first level of responsibility resides with the mRPC test lab crew. During any period when the mRPC chambers have a flammable component or SF6 gas flowing, the crew will be responsible for monitoring the status of the mRPC test lab gas system. Checklist shall be filled out periodically. The nature of the checklist and time intervals shall be specified in the mRPC test lab hand book. The second level of responsibility resides with the mRPC test lab Authorized GAS experts. The gas experts will be on-call 24/7 to respond to any alarm or unusual occurrence detected by the mRPC test lab crew. Performance of the mRPC test lab gas system will be maintained and monitored by the mRPC test lab Authorized gas system experts and Test Lab crew.

During watch shifts or data taking, it will be the responsibility of the mRPC test lab Crew to:

2.1 Monitor the status and alarms for the gas system using the mRPC test lab Checklist

2.2 **In the event of an alarm or unusual occurrence, contact an on-call** mRPC **test lab Authorized GAS expert.**

The second level of responsibility is the gas experts. It is the responsibility of the Gas experts to:

2.3 Maintain the mRPC test lab Gas System in a safe operating condition. This includes:

2.3.1 Changing gas cylinders and dewars when required

2.3.2 Setting, adjusting, and checking the gas mixture, flow rates and pressures.

2.3.3 Checking the certification of the operating gas

2.3.4 Posting any special instructions or notifications as required

2.3.5 Carrying out any emergency actions, as prescribed in the Procedures section of this document.

3.0 Prerequisites

The personnel working on or with the mRPC gas system shall have read or have training in the following areas:

3.1 PHENIX mRPC test lab Training,

3.2 BNL Compressed Gas Safety Training Course,

3.3 BNL Electrical Safety I

3.4 CA User and PHENIX Awareness

3.5 BNL Haz-com

3.6 BNL General Employee Training

4.0 Precautions

The safety of personnel is of primary importance. The mRPC test lab Gas experts shall take great care to ensure that the mRPC test lab Gas Systems will be operated in a way that does not place personnel or equipment at risk of physical harm. The mRPC test lab gas system shall not be operated without the SF6 monitoring system and fire detection system being on. Information on these system can be found in PHENIX controlled document PP-2.5.5.6-12.

5.0 Start up Procedure

(Use Figures 1, 2 & 3 for reference)

Turning on the system:

1. Make sure all manual valves on the bottle regulator, and both the regulator/shutoff rack and the mixing rack are closed (MV 1,2,3,4-F; MV 1,2,3,4-I; MV 1,2,3,4-S).

2. Connect bottle regulators to cylinders (Freon 134a uses CGA 660, isobutane uses CGA 510, and SF6 uses CGA 590), open cylinder valves slowly, and check for leaks at the bottle fitting using either a portable leak detector or leak solution (Snoop).

3. Adjust bottle regulators to 25-30 psi output pressure, and open regulator output valves (MV 1-F, MV 1-I, MV 1-S) so that the flow reaches the regulation rack. Open and close

MV 2-F, MV 2-I, MV 2-S one at a time for a few seconds to allow each line to purge into a common vent line.

4. Open MV 3-F, MV 3-I, and MV 3-S one at a time to allow pressure to reach the regulators (PCV 2-F, PCV 2-I, and PCV 2-S), and adjust output pressures to 20 psi on PG 3-F, PG 3-I, and PG 3-S.

5. Check the shutoff alarm status on the switching panel (just above the regulators) by looking at the indicator lights. If the three white indicator lights are on, the solenoids are powered and open. If these lights are off, and the red light on SW 2 is lit, an alarm has turned off the solenoid valves. Pressing the switch will acknowledge the alarm, and reset the solenoids – if the sensors are no longer in alarm. Normally, the solenoids are turned on and off using SW 1.

Turning on the mixer:

Although it is likely that the system will be in constant use much of the time, there will be an occasional need to turn it off and on. When turning the system on, there is always some period of time when the mixture is unstable. Until the mixer reaches a steady state condition (1 hour at 300ccm) the mixture should be vented outside.

1. On the Cosmic Ray distribution rack (CR) inside the tent –open MV1-CR.

2. At this time, ensure that the vent flowmeter (FM1-CR) is open and will not restrict the flow. This will allow the mixer output to be vented into an exhaust line, as well as allowing the supply line to the distribution rack to be purged with fresh gas once the mixer is turned on.

3. Open the three input valves (MV 4-F, MV 4-I, MV 4-S) located at the base of the mixing rack outside the tent.

4. The input pressure gauges (PG 4-F, PG 4-I, PG 4-S) should all read 20 psi.

5. Turn on mixer using switch on back of control box mounted on top of the mixing rack. This allows flow through the mass flow controllers (MFC 1-F, MFC 1-I, MFC 1-S), and the electronic display on the control box should read the measured flow going through each controller. This flow is visually indicated with the flow indicators (FI 1-F, FI 1-I, FI 1-S) that are immediately downstream of each mass flow controller.

6. The combined flow should now be visually observed with the mixer output flowmeter (FM 1-M).

7. This flowmeter should be adjusted to allow all the mixed gas through without building up

pressure within the mixer, as observed on the mixing pressure gauge (PG 1-M should read only a few inches of pressure).

Procedure to flow including purging the chamber::

An input valve (MV 2-CR) allows for the selection of either nitrogen or mixed gas for a group of up to 10 channels on the distribution rack. The entire flow to the rack is adjusted with the input flowmeter (FM 2-CR). Both racks contain 10 output flowmeters. They are both located inside the tent, next to the Cosmic Ray test stand. For the purpose of the mRPC chambers, 8 of the 10 gas channels will be capped at each rack to prevent accidental discharge into the room. The input lines connect the panel flowmeters (FM 3-CR and FM 4-CR) to the test chamber, and the exhaust lines are connected to the exhaust bubblers (BU 1-CR through BU 2-CR).

Note: If the chamber was opened, the vessel must be pressure tested to ensure no leaks before mixed gas can be applied. Leak Test procedures are in Appendix B.

1. Ensure normal flow through the distribution rack by turning MV 2-CR to the "nitrogen" position, and observe the flow in the distribution flowmeters (FM 3-CR and FM 4-CR). The flow through each flowmeter should be between 50 CCM - before any lines are connected to the chambers.

2. Make sure the flow is consistent through both flowmeters, and adjust if necessary.

3. After verifying flow, turn MV 2-CR to the "off" position, and connect the appropriate input/exhaust lines to the chamber being tested.

4. Turn MV 2-CR to the "nitrogen" position, and verify flow through all chambers by observing the bubble rate for each chamber.

5. If the mixer has just been turned on, allow it to stabilize during the time the chambers are are being connected and purged with nitrogen.

6. Allow chambers to purge with nitrogen for 6 volume turnovers and then switch MV 2-CR over to "mixed gas". At this point the chambers should be purged for at least 6 volume changes before applying HV.

7. Once the tests are complete, the chambers should be purged with nitrogen again, by turning MV 2-CR to the "nitrogen" position and allowing flow through the chambers for 6 turnovers to inert the chamber.

8. Turn off flow at MV 2-CR, and disconnect all lines to chambers, cap lines.

9. If the mixer is no longer needed, close MV 4-F, MV 4-I, and MV 4-S, and turn off mixer. This should be done shortly after chambers are switched over to nitrogen.

10. Close off all three cylinder valves for the Freon 134A, the isobutane, and the sulfur hexafluoride.

11. Release the high pressure side of the bottle regulators by momentarily opening the line purge valves (MV 2-F, MV 2-I, MV 2-S).

For the experienced operator, a simplified list of instructions is on Appendix A for switching chambers

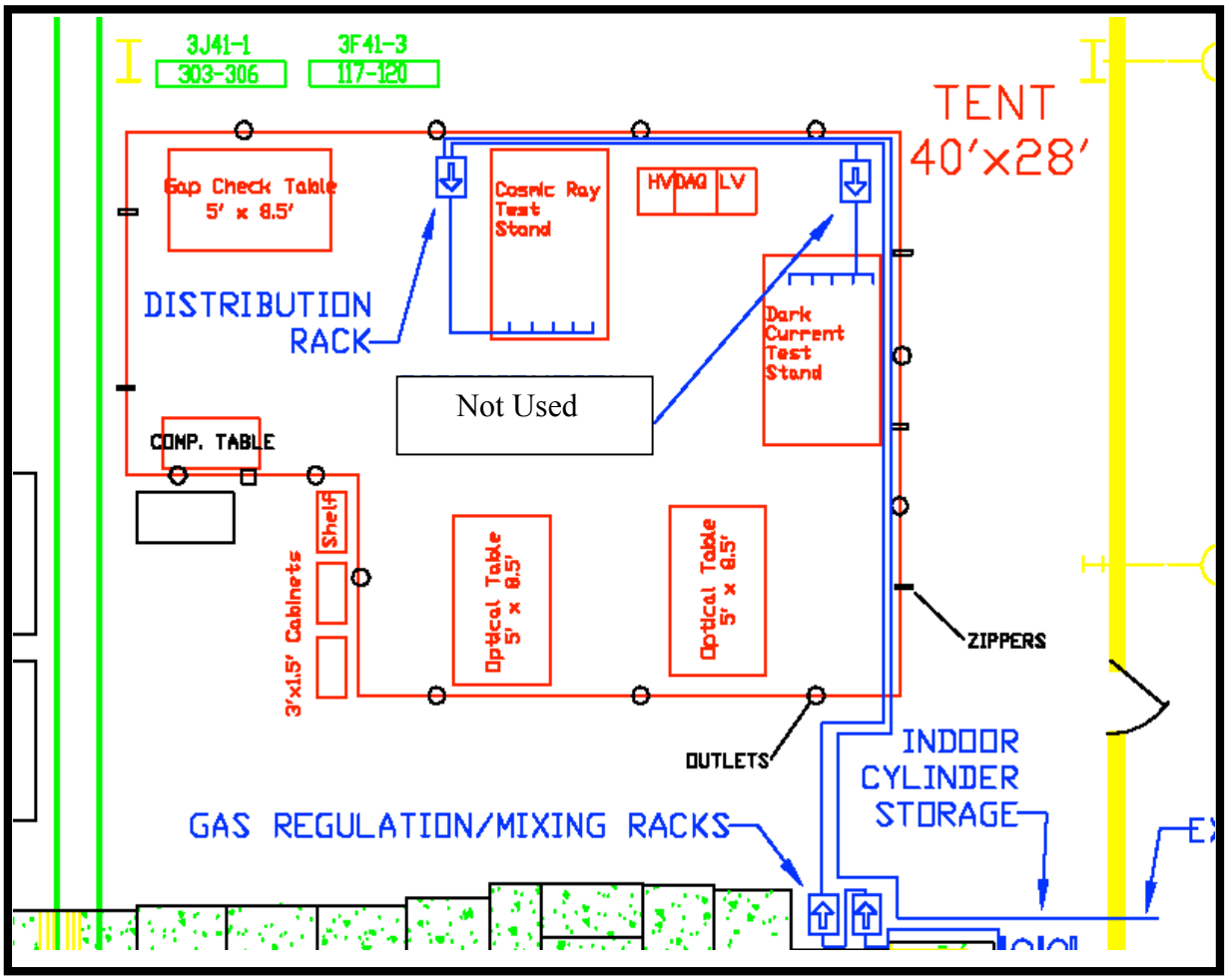

Figure 1: mRPC **Test Lab** Gas Line Layout. mRPC uses the Cosmic Ray Stand.

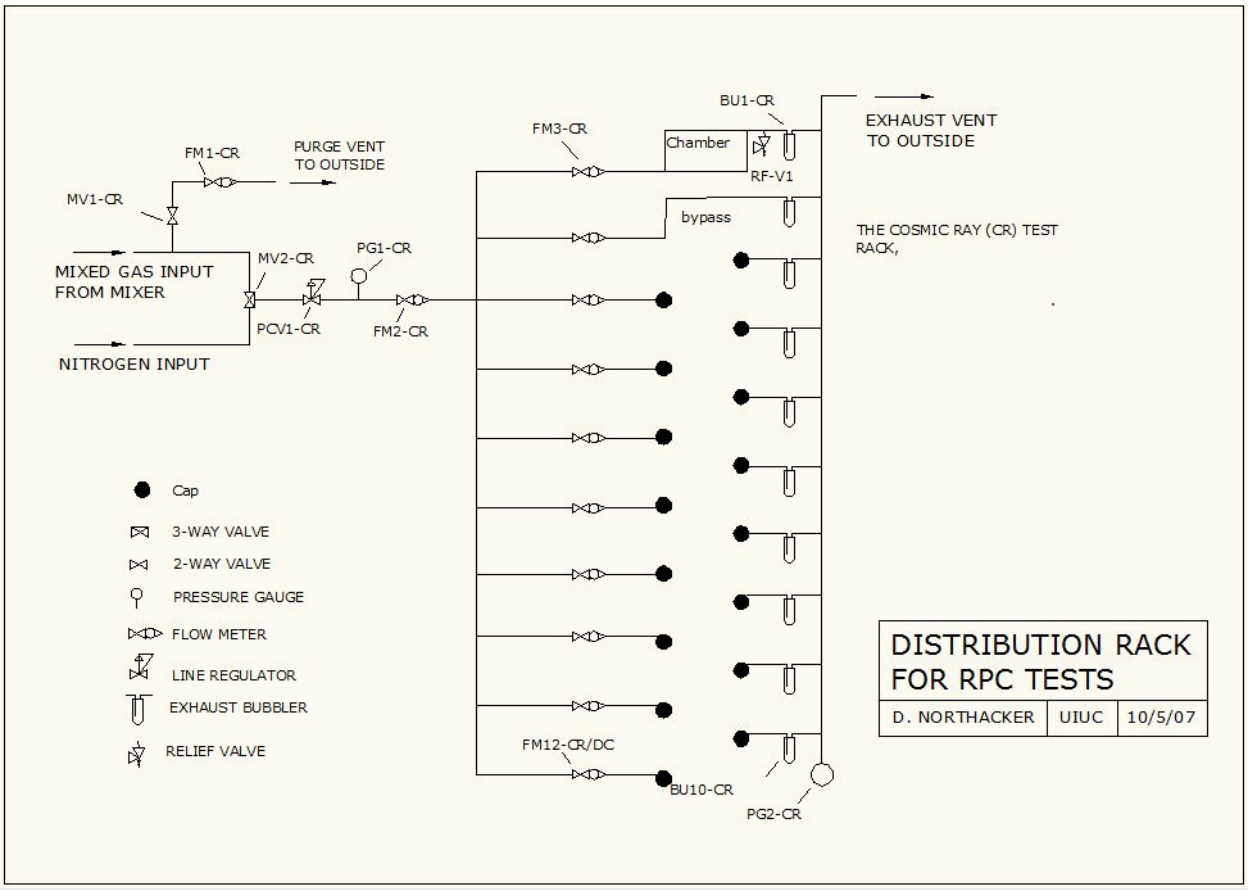

Figure 2: Distribution Rack for mRPC **test lab** Gas System

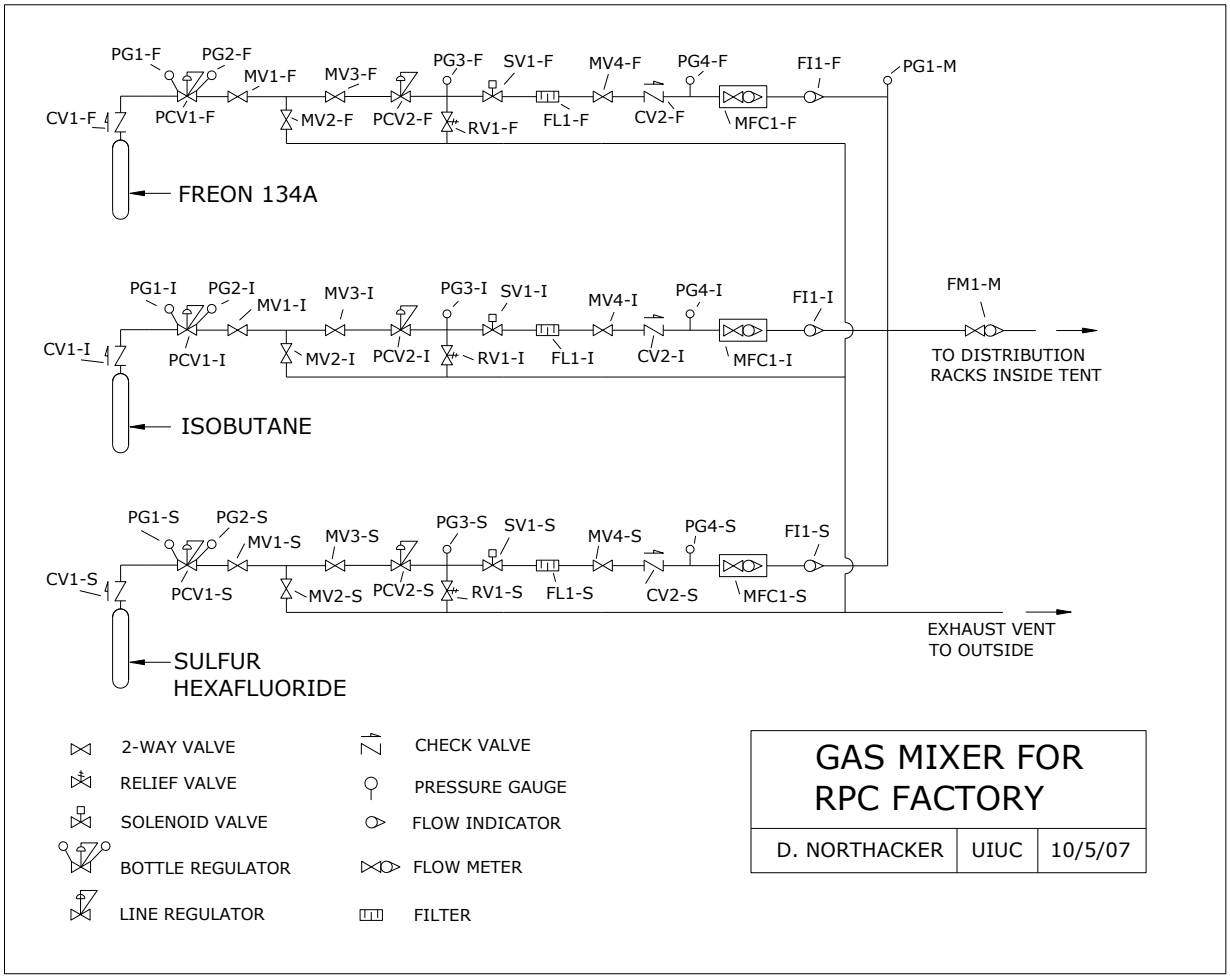

Figure 3: Gas Mixer for mRPC Test Lab

Appendix A: Quick instructions for flowing to new chamber

Note: If Chamber was opened, the vessel must be pressure tested to ensure no leaks before mixed gas can be applied.

1 Open MV 2-CR to the “nitrogen” position, and observe the flow in the distribution flowmeters (FM 3-CR and FM 4-CR).

2 After verifying flow, turn MV 2-CR to the “off” position, and connect the appropriate input/exhaust lines to the chamber being tested.

3 Turn MV 2-CR to the “nitrogen” position, and verify flow through all chambers by observing the bubble rate for the chamber.

4 Allow chambers to purge with nitrogen for 6 volume turnovers

5 Switch MV 2-CR over to “mixed gas”.

6 At this point the chambers should be purged for at least 6 volume changes before applying HV.

7 After 1 turn over, a hand held Freon sniffer should be used to confirm no leaks in the connection lines and vessel

8 Once the tests are complete, turnMV 2-CR to the “nitrogen” position to purge operating gas

9 Allow N2 flow through the chamber for 6 turnovers to inert the chamber.

10 Turn off flow at MV 2-CR, and disconnect all lines to chambers, cap lines.

11 If the mixer is no longer needed, close MV 4-F, MV 4-I, and MV 4-S, and turn off mixer.

12 Close off all cylinder valves for the Freon 134A, the isobutane, and the sulfur hexafluoride.

13 Release the high pressure side of the bottle regulators by momentarily opening the line purge valves (MV 2-F, MV 2-I, MV 2-S).

Appendix 2: Leak Testing a Vessel

1 Inspect all gaskets to be sure they are still in good condition.
2 Close FM2-CR
3 Turn MV2-CR to Nitrogen source.
4 Connect a low pressure gauge PG-T1 (5"W.C.) and Valve MV-T1 to chamber
5 Connect tube from FM3-CR to chamber
6 Connect Relief Valve RF-V1 and Manual Valve MV-T2 to chamber exhaust
7 Close MV-T2, Open MV-T1
8 Open the input valve FM3-CR very slowly and increase the pressure of the vessel to 5" of W.C
9 Close the valve MV-T1 and record the pressure of the gauge PG-T1.
10 Wait 15 minutes and record the reading on the gauge PG-T1.
11 The chamber should drop no more than 0.5" W.C. in that time.

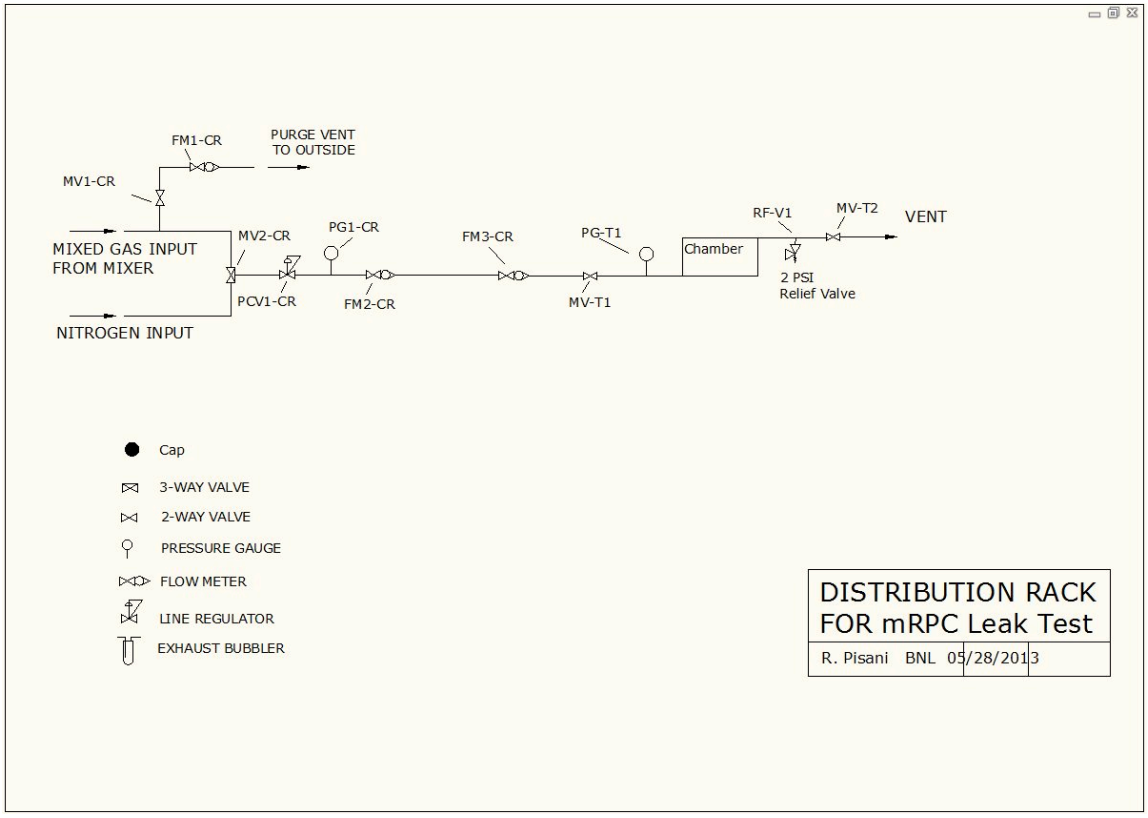

Figure 4: Setup for Vessel Leak Test